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(54) **Low-pressure mercury vapour discharge lamp**

Niederdruckquecksilberdampfentladungslampe

Tube à décharge dans la vapeur de mercure à basse pression

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(56) References cited:
WO-A-87/04562 **US-A- 2 465 414**
US-A- 4 266 167

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Description

The invention relates to a low-pressure mercury vapour discharge lamp having a discharge vessel filled with mercury and a rare gas, which discharge vessel comprises two substantially parallel, mainly rectangular flat glass plates which are located at a relatively short distance from each other and which are transparent to light, said plates being connected together in a gas-tight manner proximate their circumference and forming upright walls, electrodes between which a discharge is maintained in the discharge vessel during operation being arranged on the outside of the discharge vessel.

A lamp of this type equipped with a plurality of electrodes along facing upright walls is known from WO-A-87/04562. Another lamp of this type having electrodes formed of thin transparent and conducting layers arranged on the outer side of the flat substantially rectangular glass plates is known from Japanese patent application 61-4152(A) laid open to public inspection.

These flat lamps are used as light sources for rear exposure of information display devices comprising liquid crystal material and having a flat display screen.

Such a display device comprises, for example a chamber having two electrically insulating transparent plates between which liquid crystal material is present. The surfaces of the insulating plates facing the liquid crystal material are provided with planar electrodes. Dependent on the potential difference between the electrodes and a special polarizer, bright symbols are displayed against a dark background, and conversely, by means of the light source placed behind the display device. The said light source exposing the display device particularly on the rear side is preferably a fluorescent low-pressure mercury vapour discharge lamp having a flat rectangular discharge vessel as described *inter alia* in the said Japanese Patent Application. Such a light source has a high brightness and the rear side of the display device is exposed over a maximum possible surface area.

In the flat discharge vessel of the lamp known from the Japanese Patent Application the electrodes are arranged on the outer side of the flat substantially rectangular glass plates and they are formed as thin transparent conducting layers (comprising, for example conducting indium oxide) which layers extend substantially throughout the surface. The glass plates are substantially rectangular but this is also understood to mean a square, whilst small deviations such as roundings may be possible. During operation of the lamp a high-frequency alternating voltage is maintained between the electrodes, whilst ultraviolet radiation which is converted into visible light by a luminescent layer provided on the inner wall of the discharge vessel is generated in this discharge vessel. However, it has been found that due to the relatively large surface of the electrodes in the known lamp the discharge readily contracts in the discharge vessel during operation, resulting in local in-

tensity differences. To prevent such a contraction of the discharge, the distance between the said plates should be determined very accurately. Such an accuracy requirement must also be imposed on the thickness of the said glass plates. This is troublesome and hence time-consuming and costly, notably in lamps manufactured in a mass production process.

It be mentioned that US-A-2,465,414 discloses a discharge lamp for operation with a high-frequency and having a flat rectangular discharge vessel, provided with electrodes extending along the side walls. That lamp has a relatively complex construction in which the side walls have a recess that protrudes into the discharge vessel, a portion of the corresponding electrode extending into the recess. The kind of filling in the discharge vessel is not disclosed.

It is an object of the invention to provide a lamp having a construction in which the above-mentioned drawback is obviated as much as possible.

According to the invention a lamp of the type described in the opening paragraph, the electrodes being substantially flat, is therefore characterized in that the electrodes are in the form of strips of conducting material which are at least arranged 5 on two facing upright walls and which extend substantially throughout the length of said walls.

A lamp according to the invention has a 'high light output and a homogeneous brightness throughout the surface area. Since the electrodes only extend on the upright walls of the flat discharge vessel, the electrodes can easily be provided and they need not be transparent. These lamps can therefore be manufactured in a relatively simple way.

In a special embodiment of the lamp according to the invention the electrodes extend on the upright walls adjoining the long sides of elongate rectangular glass plates. It has been found that the lamp then ignites readily. Moreover, the lamp has a homogeneous brightness.

Another embodiment of a lamp of the type described in the opening paragraph is according to the invention characterized in that the electrodes are in the form of strips of conducting material which are at least arranged on two facing upright walls and which extend substantially throughout the length of said walls, each electrode further extending on two adjoining upright walls, whilst some space is present between the ends of the electrodes at the location of two diagonally facing corners of the discharge vessel. The advantage of such a lamp is that notably in a discharge vessel having relatively large dimensions (for example, with rectangular glass plates of 20 x 30 cm) the discharge is readily established and is evenly distributed over the discharge vessel.

The electrodes are in the form of strips of conducting material, for example a cured conducting paste. However, each electrode preferably comprises a thin aluminium foil adhered to the outer wall and being present on substantially the complete surface area of a

side wall. Such a foil can easily be provided (for example by means of a suitable glue or cement) realizing a reliable adhesion to the relevant side walls. A qualitatively satisfactory adhesion is important for a homogeneous discharge between the electrodes.

A special embodiment of a lamp described in the opening paragraph is according to the invention characterized in that the electrodes are in the form of strips of conducting material being L-shaped in cross-section which are at least arranged on two facing upright walls which extend substantially throughout the length of said walls, and which also extend on a part of the upright wall-adjointing outer surface of one of the glass plates, whilst approximately halfway the plate a gap-shaped opening is present between the electrodes.

Electrodes are formed in this manner which extend both on the upright walls and on one of the plates (preferably the rear side of the plate-shaped discharge vessel). It has been found that the ignition voltage of the lamp is then relatively low and that the discharge is evenly distributed in the entire discharge vessel during operation. An additional advantage is that the part of the electrodes on the flat rear wall also functions as a reflector increasing the light output. In fact, a flat discharge lamp according to the invention is preferably used as a light source behind an information display device comprising liquid crystal material. Such display devices for alphanumeric information are used, for example in colour television screens and in information panels at airports, railway stations, banks, etc.

The invention will now be described in greater detail, by way of example, with reference to the accompanying drawings in which

Fig. 1 is a diagrammatic cross-sectional view of an information display device with an embodiment of a low-pressure mercury vapour discharge lamp according to the invention;

Fig. 2 is a perspective view of the lamp of Fig. 1;

Fig. 3 is a cross-section of a second embodiment of the lamp according to the invention and

Fig. 4 is a diagrammatic plan view of a third embodiment of the lamp according to the invention.

The device of Fig. 1 comprises a rectangular, elongate synthetic material thin-walled housing 1 whose upper side is at least partly closed by a transparent plate 2. The housing accommodates a liquid crystalline display device comprising two glass supporting plates 3 and 4 which are provided with electrodes 5 and 6 comprising material which is conventionally used in the LCD technique. Orientation layers 7 and 8 are provided on the supporting plate surfaces provided with electrodes. A liquid crystal material 9 is present between the supporting plates. The distance between the plates 3 and 4 is several microns in this example. In the drawing the dimensions are not in conformity with reality. They are exaggerated for the sake of clarity. A sealing edge 10

connects the supporting plates at their circumference. The supporting plates are also provided with a linear polarizer (such as 11) and an analyzer 12.

Electrode 6 may be a single electrode which functions as a counter electrode for all electrodes 5 provided in a given arrangement. For the further operation of this display device reference is made to European Patent Application EP-A-0,255,158 (PHN 11.807) laid open to public inspection.

One side of the said display device is exposed by a low-pressure mercury vapour discharge lamp 13 according to the invention having a rectangular flat discharge vessel. This lamp will be described in greater detail with reference to Fig. 2. The lamp is operated by means of two electrodes 28 and 29 between which a high-frequency voltage is maintained by means of the supply unit 16 shown diagrammatically.

The lamp of Fig. 2 has a discharge vessel 21 which is filled with mercury and a rare gas. The discharge vessel comprises two substantially parallel, rectangular glass plates 22 and 23 located at a relatively short distance from each other and being transparent to light, which plates are connected together in a gas-tight manner at their circumference. (see also Fig. 1). Upright walls 24, 25, 26 and 27 are then formed. The inner sides of the glass plates 22 and 23 and of the walls 24 to 27 are provided with a luminescent layer which converts the ultraviolet radiation generated in the discharge vessel into visible light. The electrodes 28 and 29 are arranged on the outer side of the side walls 24 and 25. These electrodes are in the form of strips of conducting material (such as a foil of aluminium) which extend substantially throughout the length of the walls. These strips are secured to the outer side of the walls by means of a cement. A discharge is maintained between these electrodes during operation of the lamp by applying a high-frequency voltage between these electrodes. As is apparent from the drawing, the electrodes extend on the upright walls which adjoin the long sides of the rectangular glass plates. In a practical embodiment a high-frequency voltage of approximately 300 V with a frequency of between 1 and 20 MHz is applied between the electrodes 28 and 29. The dimensions of the plates 22 and 23 are 100 x 75 mm. The height of the upright walls is approximately 9 mm so that contraction of the discharge during lamp operation is avoided.

The discharge vessel of a lamp, shown in Fig. 3, of another embodiment according to the invention has also a rectangular shape. The same components have the same reference numerals as in the lamp of Fig. 2. A luminescent layer 30 (comprising in a practical embodiment a mixture of three phosphors as described in US-A-3,937,998) is present on the inner wall of the discharge vessel. The electrodes 31 and 32 extend throughout the length of the discharge vessel, are L-shaped in cross-section and also extend on a part of the side wall-adjointing outer surface of plate 23. However, for ready ignition of the lamp a rectangular gap-shaped

opening 33 is present halfway the plate 23. It is not necessary for the parallel edges of the electrodes 31 and 32 adjoining the gap 33 to be formed as straight lines. They may also be curved or knurled. During operation of the lamp a voltage of approximately 300 V with a frequency of approximately 5 MHz is applied between these electrodes. The electrodes 31 and 32 comprise an L-shaped bent aluminium foil having a thickness of approximately 100 µm.

The embodiment of Fig. 4 only shows the upper flat rectangular glass plate 22 of the discharge vessel. This is the side of the discharge vessel from which the light emerges. The two electrodes extend on two adjoining walls. These electrodes are denoted by 41 and 42. Some space between the ends of the two electrodes 41 and 42 is present at the location of two diagonally facing corners of the discharge vessel. Proximate one end the electrodes are connected to a high-frequency supply unit 43.

Claims

1. A low-pressure mercury vapour discharge lamp having a discharge vessel filled with mercury and a rare gas, which discharge vessel comprises two substantially parallel, mainly rectangular glass plates which are located at a relatively short distance from each other and which are transparent to light, said plates being connected together in a gas-tight manner proximate their circumference and forming upright walls, electrodes between which a discharge is maintained in the discharge vessel during operation being arranged on the outer side of the discharge vessel, the electrodes being substantially flat, characterized in that the electrodes are in the form of strips of conducting material which are at least arranged on two facing upright walls and which extend substantially throughout the length of said walls.
2. A low-pressure mercury vapour discharge lamp as claimed in Claim 1, characterized in that the electrodes extend on the upright walls adjoining the long sides of elongate rectangular glass plates.
3. A low-pressure mercury vapour discharge lamp having a discharge vessel filled with mercury and a rare gas, which discharge vessel comprises two substantially parallel, mainly rectangular glass plates which are located at a relatively short distance from each other and which are transparent to light, said plates being connected together in a gas-tight manner proximate their circumference and forming upright walls, electrodes between which a discharge is maintained in the discharge vessel during operation being arranged on the outer side of the discharge vessel, characterized in that the elec-

trodes are in the form of strips of conducting material which are at least arranged on two facing upright walls and which extend substantially throughout the length of said walls, each electrode further extending on two adjoining upright walls, whilst some space is present between the ends of the electrodes at the location of two diagonally facing corners of the discharge vessel.

4. A low-pressure mercury vapour discharge lamp having a discharge vessel filled with mercury and a rare gas, which discharge vessel comprises two substantially parallel, mainly rectangular glass plates which are located at a relatively short distance from each other and which are transparent to light, said plates being connected together in a gas-tight manner proximate their circumference and forming upright walls, electrodes between which a discharge is maintained in the discharge vessel during operation being arranged on the outer side of the discharge vessel, characterized in that the electrodes are in the form of strips of conducting material being L-shaped in cross-section which are at least arranged on two facing upright walls which extend substantially throughout the length of said walls, and which also extend on a part of the upright wall-adjoining outer surface of one of the glass plates, whilst approximately halfway the plate a gap-shaped opening is present between the electrodes.
5. A low-pressure mercury vapour discharge lamp as claimed in Claim 1, 2, 3 or 4, characterized in that the strips comprise an aluminium foil adhered to the wall.
6. An information display device having a housing with a flat display screen, said housing accommodating a low-pressure mercury vapour discharge lamp as claimed in Claim 1, 2, 3, 4 or 5.

Patentansprüche

1. Niederdruck-Quecksilberdampfentladungslampe mit einem mit Quecksilber und einem Edelgas gefüllten Entladungsgefäß, welches Entladungsgefäß zwei nahezu parallele, im wesentlichen rechteckige Glasplatten umfaßt, die in relativ kurzem Abstand voneinander liegen und lichtdurchlässig sind, wobei die genannten Platten nahe ihres Randes gasdicht miteinander verbunden sind und aufrecht stehende Wände bilden, wobei an der Außenseite des Entladungsgefäßes Elektroden angeordnet sind, zwischen denen im Betrieb in dem Entladungsgefäß eine Entladung aufrechterhalten wird, wobei die Elektroden im wesentlichen flach sind, dadurch gekennzeichnet, daß die Elektroden in Form von

Streifen aus leitendem Material ausgeführt sind, die zumindest auf zwei einander zugewandten aufrecht stehenden Wänden angeordnet sind und sich nahezu über die gesamte Länge der genannten Wände erstrecken.

2. Niederdruck-Quecksilberdampfentladungslampe nach Anspruch 1, dadurch gekennzeichnet, daß die Elektroden sich über die aufrecht stehenden Wände erstrecken, die an die Längsseiten länglicher rechteckiger Glasplatten grenzen.
3. Niederdruck-Quecksilberdampfentladungslampe mit einem mit Quecksilber und einem Edelgas gefüllten Entladungsgefäß, welches Entladungsgefäß zwei nahezu parallele, im wesentlichen rechteckige Glasplatten umfaßt, die in relativ kurzem Abstand voneinander liegen und lichtdurchlässig sind, wobei die genannten Platten nahe ihres Randes gasdicht miteinander verbunden sind und aufrecht stehende Wände bilden, wobei an der Außenseite des Entladungsgefäßes Elektroden angeordnet sind, zwischen denen im Betrieb in dem Entladungsgefäß eine Entladung aufrechterhalten wird, dadurch gekennzeichnet, daß die Elektroden in Form von Streifen aus leitendem Material ausgeführt sind, die zumindest auf zwei einander zugewandten aufrecht stehenden Wänden angeordnet sind und sich nahezu über die gesamte Länge der genannten Wände erstrecken, wobei jede Elektrode sich weiterhin über zwei aneinandergrenzende aufrecht stehende Wände erstreckt, wobei zwischen den Enden der Elektroden am Ort zweier diagonal gegenüberliegender Ecken des Entladungsgefäßes etwas Raum ist.
4. Niederdruck-Quecksilberdampfentladungslampe mit einem mit Quecksilber und einem Edelgas gefüllten Entladungsgefäß, welches Entladungsgefäß zwei nahezu parallele, im wesentlichen rechteckige Glasplatten umfaßt, die in relativ kurzem Abstand voneinander liegen und lichtdurchlässig sind, wobei die genannten Platten nahe ihres Randes gasdicht miteinander verbunden sind und aufrecht stehende Wände bilden, wobei an der Außenseite des Entladungsgefäßes Elektroden angeordnet sind, zwischen denen im Betrieb in dem Entladungsgefäß eine Entladung aufrechterhalten wird, dadurch gekennzeichnet, daß die Elektroden in Form von im Querschnitt L-förmigen Streifen aus leitendem Material ausgeführt sind, die zumindest auf zwei einander zugewandten aufrecht stehenden Wänden angeordnet sind und sich nahezu über die gesamte Länge der genannten Wände erstrecken und die sich auch über einen Teil der an die aufrecht stehende Wand grenzenden Außenfläche einer der Glasplatten erstrecken, wobei sich ungefähr halbwegs der Platte zwischen den Elektroden eine

spaltförmige Öffnung befindet.

5. Niederdruck-Quecksilberdampfentladungslampe nach Anspruch 1, 2, 3 oder 4, dadurch gekennzeichnet, daß die Streifen eine an der Wand haftende Aluminiumfolie umfassen.
6. Informationsanzeigevorrichtung mit einem Gehäuse mit flachem Anzeigeschirm, wobei in das Gehäuse eine Niederdruck-Quecksilberdampfentladungslampe nach Anspruch 1, 2, 3, 4 oder 5 aufgenommen ist.

15 Revendications

1. Lampe à décharge dans la vapeur de mercure à basse pression présentant un récipient à décharge rempli de mercure et d'un gaz rare, ledit récipient à décharge comporte deux plaques en verre principalement rectangulaires et sensiblement parallèles qui sont situées l'une espacée d'une distance relativement faible de l'autre et qui sont transparentes à la lumière, lesdites plaques étant reliées l'une à l'autre d'une manière étanche au gaz à proximité de leur circonférence et formant des parois verticales, des électrodes étant disposées à l'extérieur du récipient à décharge entre lesquelles une décharge est maintenue dans le récipient à décharge pendant le fonctionnement, les électrodes étant sensiblement plates, caractérisée en ce que les électrodes sont en forme de bandes en matériau conducteur qui sont au moins disposées sur deux parois verticales l'une faisant face à l'autre et qui s'étendent sensiblement sur toute la longueur desdites parois.
2. Lampe à décharge dans la vapeur de mercure à basse pression selon la revendication 1, caractérisée en ce que les électrodes s'étendent sur les parois verticales contiguës aux côtés longs de plaques en verre rectangulaires allongées.
3. Lampe à décharge dans la vapeur de mercure à basse pression présentant un récipient à décharge rempli de mercure et d'un gaz rare, ledit récipient à décharge comporte deux plaques en verre principalement rectangulaires et sensiblement parallèles qui sont situées l'une espacée d'une distance relativement faible de l'autre et qui sont transparentes à la lumière, lesdites plaques étant reliées l'une à l'autre d'une manière étanche au gaz à proximité de leur circonférence et formant des parois verticales, des électrodes étant disposées à l'extérieur du récipient à décharge entre lesquelles une décharge est maintenue dans le récipient à décharge pendant le fonctionnement, caractérisée en ce que les électrodes sont en forme de bandes en matériau conducteur qui sont au moins disposées sur deux pa-

rois verticales l'une faisant face à l'autre et qui s'étendent sensiblement sur toute la longueur desdites parois, chaque électrode s'étendant encore sur deux parois verticales contiguës, alors qu'un certain espace est présent entre les extrémités des électrodes à l'endroit de deux coins diagonalement opposés du récipient à décharge.

4. Lampe à décharge dans la vapeur de mercure à basse pression présentant un récipient à décharge rempli de mercure et d'un gaz rare, ledit récipient à décharge comporte deux plaques en verre principalement rectangulaires et sensiblement parallèles qui sont situées l'une espacée d'une distance relativement faible de l'autre et qui sont transparentes à la lumière, lesdites plaques étant reliées l'une à l'autre d'une manière étanche au gaz à proximité de leur circonférence et formant des parois verticales, des électrodes étant disposées à l'extérieur du récipient à décharge entre lesquelles une décharge est maintenue dans le récipient à décharge pendant le fonctionnement, caractérisée en ce que les électrodes sont en forme de bandes en matériau conducteur étant formées en L en coupe transversale, qui sont au moins disposées sur deux parois verticales l'une faisant face à l'autre et qui s'étendent sensiblement sur toute la longueur desdites parois, et qui s'étendent également sur une partie de la surface extérieure contiguë à la paroi verticale de l'une des plaques en verre, alors qu'approximativement à égale distance de la plaque une ouverture en forme d'interstice est présente entre les électrodes.
5. Lampe à décharge dans la vapeur de mercure à basse pression selon la revendication 1, 2, 3 ou 4, caractérisée en ce que les bandes comportent une feuille en aluminium adhérente à la paroi.
6. Dispositif d'affichage de renseignements muni d'un boîtier présentant un écran d'affichage plat, ledit boîtier recevant une lampe à décharge dans la vapeur de mercure à basse pression selon la revendication 1, 2, 3, 4 ou 5.

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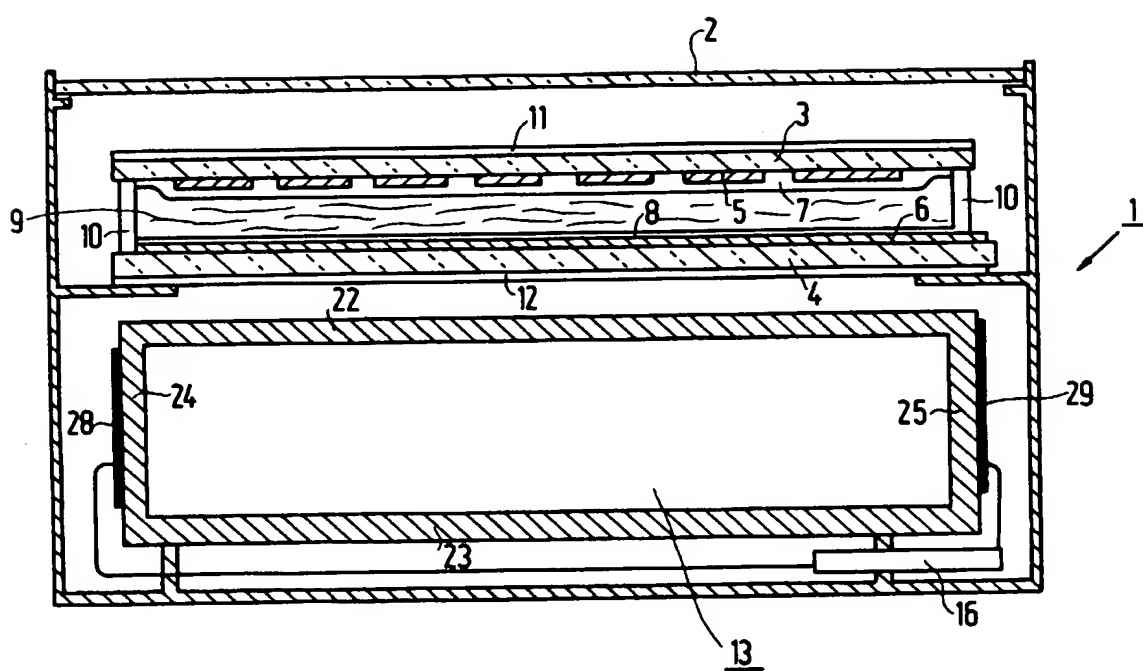


FIG.1

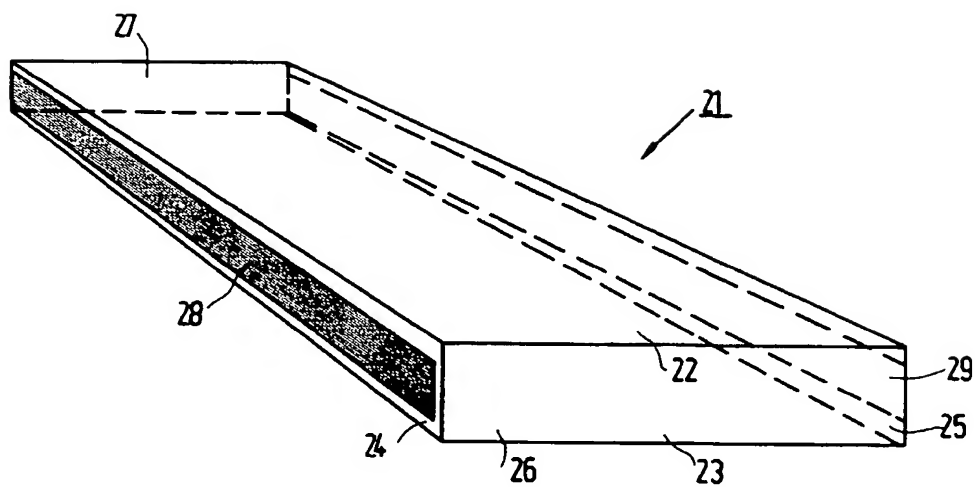


FIG. 2

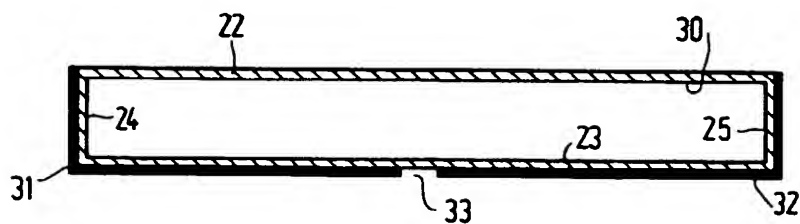


FIG. 3

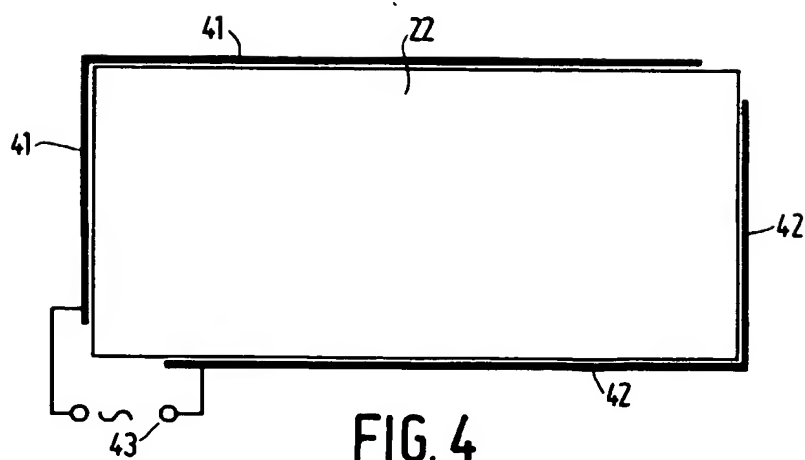


FIG. 4